When pressure sinks performance: Evidence from diving competitions

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When pressure sinks performance: Evidence from diving competitions[1]

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Abstract

Tournaments are designed to enhance participants' effort and productivity. However, ranking near the top may increase psychological pressure and reduce performance. We empirically study the impact of interim rank on performance using data from international diving tournaments. We find that competitors systematically underperform when ranked closer to the top, despite higher incentives to perform well.

JEL codes: J24, L83, M52, Z13.

Keywords: Tournaments, incentives, choking under pressure.

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1. Introduction

It is common for workers to compete in tournaments for rewards based on relative performance. A growing literature has emerged on the effects of tournaments on labor market outcomes. While competition may lead to enhanced performance, some studies suggest that the incentives provided by tournaments may also increase psychological pressure, ultimately diminishing performance (Ariely et al 2005; Dohmen, 2008; Apesteguia and Palacios-Huerta 2009, Genakos and Pagliero 2012).

In this paper, we focus on how interim ranking in a dynamic tournament affects performance. We start with the observation that performance pressure on those leading the competition is likely different from the pressure on those lagging behind. We then focus on how performance varies depending on interim ranking, while holding constant the type of task being performed.

This paper contributes to the existing literature in two ways. First, it exploits a unique feature of diving competitions: an athlete's entire dive list is announced before the competition begins.[5] No changes are allowed. Thus, the full list of movements to be performed within each competition is completely predetermined. Relative to Genakos and Pagliero (2012), this feature greatly simplifies the analysis of the impact of interim rank on performance, since athletes' strategies cannot respond to events during the competition.

Second, this paper provides an interesting test of the external validity of previous results regarding the effect of rank on performance obtained using data on weightlifting competitions (Genakos and Pagliero, 2012). In fact, although the skill sets required by competitive diving and weightlifting are completely different (agility vs. strength), we still find consistent evidence that professional divers, like weightlifters, underperform when close to the top of

[5] Each dive is identified by an alphanumeric code and its degree of difficulty. Athletes must perform the exact movements required for the announced dives.

the interim ranking. This result is robust to additional controls for fatigue, intensity of the competition or the potential gain in rank from a well-executed dive.

2. Diving competitions and the data

In diving, athletes jump into the water from a platform or springboard while performing acrobatics. Athletes are divided by gender, and most competitions consist of three disciplines: 1m and 3m springboards, and the platform (10m). In major events, there is a preliminary and a semi-final stage. The best athletes then compete in the finals.

Divers submit a list of dives they intend to perform *before* the event.[6] Each dive has a fixed degree of difficulty, depending on what combination of twists, tucks, pikes and somersaults it involves. During the competition, the athletes perform their list of dives in sequence and a panel of judges awards them a score for each dive.[7] An interim score is calculated after each attempt based on the cumulative score of dives taken so far. The diver with the highest total score at the end of the competition is declared the winner.

The relationship between final rank and prizes is convex, although it is not precisely observable to the researcher. Direct monetary prizes for diving are smaller than for more popular sports like tennis and golf. However, indirect rewards such as media coverage, private sponsorships, and other benefits such as civil service jobs are often enjoyed by athletes winning medals in international competitions.

We collected round-by-round data from the international governing body of aquatic sports (FINA) for all divers participating in the finals of Olympic Games, World and European Championships, and Champions Cup from 1988 to 2012, yielding over 7,500 individual stage-specific observations for 515 athletes. For each observation we know the type of competition, date, athlete's name, discipline, the degree of difficulty and score achieved for

[6] The number of dives in the finals has varied over the years (between 5 and 11).
[7] Each of seven judges awards from 0 to 10 points for every dive. The final score for each dive is calculated by deleting the two highest and two lowest scores and summing the remaining scores.

each dive, together with the final overall ranking of each competition. From this, we reconstructed the interim ranking of all athletes at each stage of the competition.

3. Empirical Framework

We estimate the impact of interim rank on performance using the following model:

$$Score_{itjs} = X_{itj}\delta_0 + g\left(Rank_{itj(s-1)}, \delta_1\right) + \delta_2 Difficulty_{itjs} + \tau_{itj} + u_{itjs} \qquad (1)$$

where $Score_{itjs}$ is the score obtained by athlete i, in year t, competition j, and stage s.[8] $Difficulty_{itjs}$ is the degree of difficulty, and $Rank_{itj(s-1)}$ is the interim rank in the previous stage. Our main interest is in the vector of parameters δ_1 in the flexible functional form $g(\cdot)$, which describes the impact of rank on the score achieved, controlling for the degree of difficulty.

We correct for unobserved heterogeneity by extensively controlling for fixed effects. In particular, the error term in (1) can be decomposed as:

$$u_{itjs} = \tau_i + \tau_t + \tau_j + \tau_{it} + \tau_{ij} + \tau_{tj} + \tau_{itj} + \eta_{itjs} \qquad (2)$$

where η_{itjs} describes the random component of performance, $\eta_{itjs} \sim \text{IID}(0,\sigma_\eta^2)$. This idiosyncratic component allows for random errors by the athletes, or for unforeseen circumstances affecting performance during a specific dive. Our most general specification allows for athlete-year-competition fixed effects.

4. Results

We explore the relationship between interim rank and the score for a dive using a fully flexible dummy-variable specification, $g(Rank_{itj(s-1)}, \delta_1) = \Sigma_n \delta_{1n} Rank(n)_{itj(s-1)}$. Table 1 reports the results using alternative fixed effects specifications. The omitted rank category

[8] In stage s, athletes must perform the s^{th} dive in their list. The first stage is dropped because the interim ranking is not defined.

corresponds to the athlete ranked first, so all the rank coefficients measure the impact of being ranked n^{th} relative to being first. Figure 1 plots the estimated coefficients.

Controlling for multiple sources of unobserved heterogeneity has a substantial impact on the results. There is no significant correlation between interim ranking and score when we control for athlete, year, and competition fixed effects separately (Table 1, columns 1 and 2). However, as we control for additional sources of unobserved heterogeneity, a positive and statistically significant relationship appears (Table 1, columns 3 to 5).[9] The magnitude of the impact is also substantial. The score of an individual dive varies between 0 and 30, and a shift from first to tenth place implies an increase in score of about 5 points, which is about 23 percent of the mean score in the sample.

Robustness

Table 2, column 1 shows that interim rank has a positive and significant effect on performance. When we also control for fatigue using the cumulative degree of difficulty attempted in previous stages (column 2), the impact of rank is virtually unchanged. Subsequently, we control for the intensity of competition. We compute the number (N_{itjs}) of athletes $k \neq i$ with interim score s_{ktjs} within a 10 point radius: $(s_{itjs}-10) \leq s_{ktjs} < (s_{itjs}+10)$. We then construct a binary indicator for close competitions, which is equal to one when more than 50 percent of the competitors are within the 10 point radius ($N_{itjs}/N>0.5$). The impact of interim rank remains positive.

Finally, the potential gain in rank from executing a perfect dive may increase as ranking declines; this may lead athletes to exert greater effort, resulting in better performance. We compute for each observation the potential improvement in rank position deriving from a perfectly executed dive, given the observed performance of all the other competitors. Including this variable has no substantial impact on the effect of interim rank (column 4).

[9] This result is driven by omitted variable bias. Individuals with greater ability are likely to be ranked towards the top, and they also perform better on average. When we do not control for individual characteristics, the rank variable captures the impact of differences in quality, so the performance at the top of the ranking is overestimated.

7. Conclusions

Our analysis of diving competitions contributes to the existing literature by showing that "choking under pressure" does not depend on the type of task performed by competitors; nor does it depend on the timing of announcements or on whether the performance measure is discrete or continuous. Our findings on underperformance at the top also have important implications. For example, tournament organizers could withhold information about interim ranking during the competition or provide rough information about relative performance in order to increase the performance of the interim winners.

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FIGURE 1: THE IMPACT OF INTERIM RANK ON PERFORMANCE

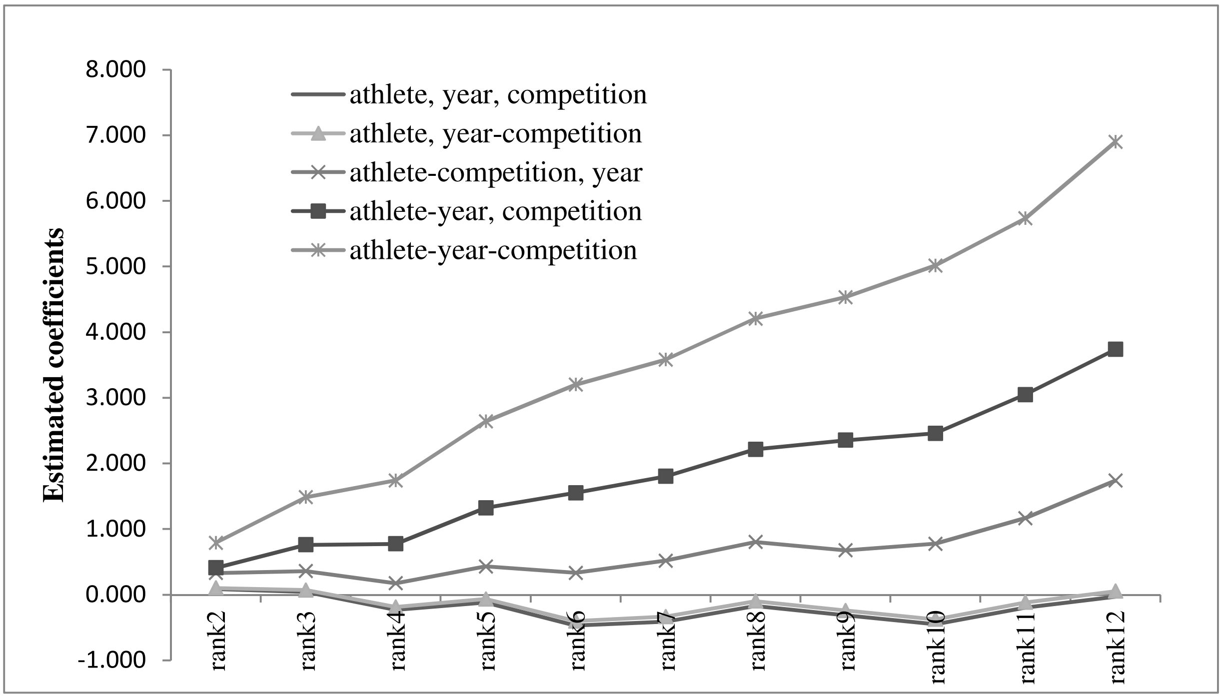

TABLE 1 - THE IMPACT OF INTERIM RANK ON PERFORMANCE IN DIVING

	(1) Score $_{itjs}$	(2) Score $_{itjs}$	(3) Score $_{itjs}$	(4) Score $_{itjs}$	(5) Score $_{itjs}$
Degree of Difficulty$_{itjs}$	-3.899***	-3.904***	-3.930***	-4.102***	-4.103***
	(0.237)	(0.237)	(0.240)	(0.257)	(0.232)
Rank 2	0.087	0.102	0.330	0.408*	0.791***
	(0.203)	(0.204)	(0.229)	(0.231)	(0.211)
Rank 3	0.044	0.069	0.358	0.760***	1.486***
	(0.204)	(0.209)	(0.239)	(0.270)	(0.232)
Rank 4	-0.229	-0.189	0.173	0.774**	1.742***
	(0.219)	(0.224)	(0.262)	(0.300)	(0.254)
Rank 5	-0.119	-0.066	0.431*	1.321***	2.640***
	(0.213)	(0.214)	(0.254)	(0.322)	(0.279)
Rank 6	-0.468**	-0.404*	0.333	1.550***	3.200***
	(0.234)	(0.238)	(0.293)	(0.362)	(0.283)
Rank 7	-0.413	-0.336	0.519	1.803***	3.580***
	(0.304)	(0.305)	(0.366)	(0.411)	(0.338)
Rank 8	-0.174	-0.098	0.803**	2.213***	4.206***
	(0.284)	(0.288)	(0.340)	(0.416)	(0.334)
Rank 9	-0.313	-0.242	0.677*	2.352***	4.532***
	(0.320)	(0.322)	(0.392)	(0.447)	(0.374)
Rank 10	-0.449	-0.377	0.777**	2.457***	5.016***
	(0.314)	(0.316)	(0.375)	(0.451)	(0.381)
Rank 11	-0.198	-0.118	1.166***	3.046***	5.735***
	(0.321)	(0.326)	(0.397)	(0.461)	(0.401)
Rank 12	-0.032	0.052	1.739***	3.737***	6.900***
	(0.350)	(0.352)	(0.449)	(0.528)	(0.440)
Observations	7,507	7,507	7,507	7,507	7,507
Clusters	515	515	515	515	515
Athlete FE	yes	yes			
Competition FE	yes			yes	
Year FE	yes		yes		
Competition-Year FE		yes			
Athlete-Competition FE			yes		
Athlete-Year FE				yes	
Athlete-Year-Competition FE					yes

Notes: All equations include stage of the competition and discipline binary indicators. Standard errors clustered at the athlete level are reported in parentheses: *significant at 10%; **significant at 5%; ***significant at 1%.

TABLE 2 - THE IMPACT OF INTERIM RANK ON PERFORMANCE IN DIVING - ROBUSTNESS

	(1) Score $_{itjs}$	(2) Score $_{itjs}$	(3) Score $_{itjs}$	(4) Score $_{itjs}$
Degree of Difficulty$_{itjs}$	-4.105***	-4.113***	-4.044***	-2.616***
	(0.232)	(0.229)	(0.234)	(0.188)
Rank$_{itj(s-1)}$	0.574***	0.572***	0.573***	0.389***
	(0.036)	(0.036)	(0.036)	(0.025)
Fatigue		-0.226**		
Cumulative degree of difficulty attempted		(0.094)		
Close Competition			0.498***	
Dummy = 1 if competitors' density within 10 points radius is high			(0.175)	
Potential Gains				-1.153***
Number of gained ranks if perfect score				(0.031)
Observations	7,507	7,507	7,507	7,507
Clusters	515	515	515	515
Athlete-Year-Competition FE	yes	yes	yes	yes

Notes: All equations include stage of the competition binary indicators. Standard errors clustered at the athlete level are reported in parentheses: *significant at 10%; **significant at 5%; ***significant at 1%.